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AGROTECHNOLOGY AND FOOD RESOURCES

No. 9

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ACADEMIC ACHIEVEMENTS

Moscow ZNAMYA in Russian No 9, 1980 pp 175-187

[Article by Valeriy Knyazyuk: "The Arable Land of Academe"]

[Text] "The party is counting on the effective assistance of our scientists, in the USSR Academy of Sciences, republic and sectorial academies and all scientific research institutes in solving the pressing problems confronting agriculture, especially on the eve of the next five-year plan," from a speech delivered by L. I. Brezhnev at the November plenum of the CC CPSU (1979)

Whatever the route of present-day Ukrainian science one travels, one sees the ponderable practical results of the work of scientists. And, although, as we know, academic science is primarily fundamental and comprehensive in its search for new routes of learning, it is by far not the speculative fruit of the labor of theoretical researchers that is regularly ripening on the branches of the "theory tree."

I should like to tell about the immediate return of science in only one, but very important branch of the national economy, in agriculture.

1.

"We believe that every scientist has the obligation of seeing his project to the end," said Fedor Semenovich Babichev, chairman of the section for chemical engineering and biological sciences and vice-president of the Ukrainian Academy of Sciences. "This means that an idea must not only be advanced and substantiated, but that its technological effectiveness must be proven. He must help expedite introduction thereof into practice. This is the way that important national economic problems should be resolved, including those pertaining to continued development of agriculture, as spelled out by the July (1978) and November (1979) plenums of the CC CPSU."

Before my meeting with Babichev, academician of the Ukrainian Academy of Sciences, I leafed through a thin, but very pithy book, "The Ukrainian Academy of Sciences to Serve Agriculture." On its 32 pages there is information about 31 research projects. All of them have undergone practical testing.

The same book lies on the table of Babichev. Fedor Semenovich commented on its "subject" with satisfaction. It felt like we had traveled together over the lines

of the table of contents, while the extensive comments that Babichev made were like halting places along this route.

The first and second pages of this operational guide deal with the results of research on storage of sugar beets. These are the topics of this republic's institutes of botany and plant physiology.

"We produce much sugar, but the demands are growing faster," observed Fedor Semenovich. "It is very important to reduce the natural beet losses. The new methods of preserving harvests are based on treatment of rootstocks with chemical preservatives that retard both excessive growth (loss of sugar content) and rotting. Botanists have proposed the use of carbon ammoniate, which is an aqueous solution of urea and ammonium bicarbonate, while physiologists proposed sodium salts of maleic acid hydrazide."

"Are the scientists competing?"

"No, they are conducting concurrent research using different techniques. The first product inhibits respiration and cell division, while the second suppresses putrefactive bacteria and mold fungus. In both cases, there is the same reduction of loss, by a factor of 1.5. Concurrently, introduction of these products is in progress. The Azot [nitrogen] Association in Severodonetsk has set up the production of carbon ammoniate; a plant in Latvia is producing maleic acid hydrazide. Unfortunately, practical use thereof is not proceeding smoothly."

Fedor Semenovich was not speaking in generalities. He had very specific situations in mind.

Thus, physiologists originally suggested that beet plantations be treated with the hydrazide 2-3 weeks before harvesting. The results on experimental plots had revealed that sugar content was higher, while loss of sugar during subsequent storage was lower. But this method did not "take" in the fields. It only promised extra troubles, since beets were delivered by the farms in loads, by weight, without consideration of sugar content. At that time there was still no question of the initiative of the Yampol' farmers to be accountable according to quintals of sugar recovered from the beets. Let me recall, incidentally, that the following was stipulated in the decree of the USSR Council of Ministers, "On measures to stimulate improvement of sugar beet quality": from 1980 on, payment for delivery of beets will depend on their sugar content.

For the time being, only beets already delivered to plants are treated with hydrazide.

It is known that beet roots are much sweeter in October than in December and January. Winter is the main working season for sugar plants. How can one preserve the percentage of sugar before processing begins?

It would appear that this problem has been resolved by botanists, but they have their own complications. The carbon ammoniate they proposed has an unpleasant odor. The solution thereof smells of ammonium hydroxide. Some plants have categorically refused to use this product.

"I even like this odor," said Babichev smiling. "But one does not argue about matters of taste."

Fedor Semenovich himself is a chemist, who heads the chair of organic chemistry at Kiev University. He has already been on this chair for 35 years, after he graduated from the chemical faculty. It is not difficult to guess that Babichev is a chemist. He pronounces the special terms and names of new agents much too smoothly, and some of them are so difficult and long that I usually omit them for fear of confusing them.

"Since we are talking about eliminating loss during storage of harvests," Babichev continued, "let us recall a very promising and important study that is being conducted under the guidance of Boris Iyeremiyevich Verkin, academician of the Ukrainian Academy of Sciences, who is the director of the Khar'kov Physicotechnical Low Temperatures Institute."

In the guide, there are three pages covering the results of this study. I read: "Autorefrigerator with nitrogen cooling system," "Isothermal container with nitrogen cooling system," "Autorefrigerator with NAST-1 nitrogen cooling system." It was evident that the principle of quick freezing with liquid nitrogen (rather than freon, that is generally used) was applied in several of the installations.

F. S. Babichev elaborated:

"The existing refrigeration trucks have a short working time, they are complicated and inconvenient to operate. The freight has to be precooled. And the chief factor is that a large part of the fruit and vegetables does not withstand the trip in these refrigerators, let us say, from the south to the industrial centers of our country. Succulent and fragile delicacies are loaded, and sometimes a rotten mess is delivered. The physicists proposed that sturdy containers of liquid nitrogen (which has a boiling point of minus 196°) be placed in the vans. There is a tube with nozzle coming out of each of these 'small barrels,' and a fan in front of them. The driver presses a button in his cab and the fan sprays the cold jet. It is easy to hold the temperature at any specified level, ranging from plus temperatures to 20 degrees below zero."

"Are these theoretical estimates?"

"Not any more. The people of Khar'kov have already converted several of the Czech Alka autorefrigerators.* They have hauled Moldavian peaches, Crimean grapes and tomatoes, cherries and strawberries from Krasnodarskiy Kray to Moscow. The critical inspection service of that capital city deemed the produce to be of first grade."

The guide is handy, and we can find the figures referable to the economic effect. Here they are: 303 rubles saved per ton of peaches hauled, 270-370 rubles per ton of strawberries, 80 per ton of tomatoes.

What is also important is that nitrogen is available and cheap. It is discharged into the atmosphere from metallurgical plants. Collection of nitrogen into special containers has been set up in Kommunarsk and Yenakiyev, at the initiative of physicists. There was no need for capital investments, and the cost of liquid nitrogen turned out to be lower than at specialized stations.

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*Refrigerator truck.

The people in Khar'kov have proposed the installation of portable nitrogen systems on the chassis of any truck, for the storage time is extended if the gathered vegetables and fruit are cooled immediately. They have worked out in detail an extensive program for transportation of all perishable products in general, rather than only fruit and vegetables, in a nitrogen environment. At the present time, there are about 10 trucks of the Khar'kov Meat-Packing Plant equipped with the NAST-1 system. This is a sort of shower: holes have been punched at the top, in the coil, for jets of nitrogen. For the third year now, these trucks are delivering sausages and meat products to the city shops.

Freon systems did not have time to cool the interior, which the shipper had to open in front of each store. For this reason, the sanitary inspectorate prohibited the production of liverwurst, blood sausage, head cheese and jellied meats in the summer. The NAST-1 system provides the required temperature in 2-3 minutes, and any product is delivered to the counter in fresh condition. The system is simple, reliable, noiseless, safe and it does not pollute the environment. A batch of such microrefrigerators has been ordered for the catering shop for the Moscow Olympics.

The isothermal container is also interesting. Are the fish consumers who live far from the Black Sea aware of the good flavor of the Black Sea sprat, which is a small fish that is being caught more and more in fishing nets? They do not know this and could not know it, even when cooled by ice, this small fish can keep for no more than 1.5 days ("due to increased enzymatic activity," it is stated on the eighth page of the guide). Then two special containers were designed in Khar'kov, each with a 300 kg capacity, and they were put aboard a seiner. When the fish is put in this container directly from the trawl net and cooled by nitrogen fumes, it remains fresh for over 10 days.

Having submitted all this production on the table, from peaches and strawberries to fresh fish, I could not fail to ask Fedor Semenovich about the prospects of nitrogen cooling, how soon the "nitrogen shower" would become a "household item."

"The people in Khar'kov are actively searching for partners," Babichev answered. "They recently finalized an agreement with the Lutsk Motor Vehicle Plant. There, an entire batch of refrigerators is being outfitted with a nitrogen system. For the time being, I cannot cite other examples. For some reason, the manufacturers of motor vehicles are persistently directing themselves toward traditional freon in their designs of new models of 'cold' vehicles. Yet thousands of high-speed freezing installations are in operation in the United States and countries of west Europe. We should also hurry up, since slowness and conservatism lead to irreplaceable losses."

It is only necessary to deliver peaches, cherries and strawberries intact to their destination point. They will not stay around long after that. But what is to be done with apples, cabbage and potatoes? They could turn black and rot before the following spring. In both pits and warehouses, vegetables emit moisture, breathe, heat up and they are not protected against diseases. Specialists suggest that they be stored in facilities with controllable gas environment, containing admixtures of carbon dioxide and nitrogen, at a constant low temperature.

"The nation's first recirculating generator has been developed at the Kiev Gas Institute," Babichev continues. "It reliably services storage areas with a capacity

of up to 6000 tons of vegetables or fruit. Experimental production testing at bases in the Ukraine and RSFSR revealed that apples, for example, retained their nutrient properties after 8-9 months of storage. There is 3-5-fold reduction of losses."

As I listened to Babichev, I thought about the fact that, for example, in England and the United States, up to half of all fruit is stored in warehouses with a gas atmosphere. There, mainly small rooms are used, where produce is kept for short periods of time and where it consists of similar cultivars as much as possible. They are either overcrowded or empty. They are not afraid of depressurizing these tiny storage places.

We need large vegetable storage facilities, and this means large difficulties. The closed recirculation system of the Kiev plant makes it possible to increase the size of the warehouses considerably, it reduces to one-third the fuel consumption and the operating costs to one-third--one-fifth, and there is no environmental pollution. It will not be cheap to erect such warehouses, but ultimately they will be highly advantageous....

Fedor Semenovich Babichev, now turning the conversation to specifics, informed me:

"The Ukrainian Academy of Sciences has submitted a proposal to the USSR Gosplan: to charge the concerned sectors with development of designs for new refrigerators with a capacity of up to 10,000 tons. It would not be expedient to hold up this work. According to the data of the USSR Ministry of Agriculture, we lose about a quarter of a billion rubles annually only because of unsatisfactory storage conditions and processing of fruit and vegetables."

The input of information in our conversation was bulging at the seams. The facts supported one another. Each was important in its way and, like a tessera, formed a mosaic. Now Fedor Semenovich, thumbing through the reference booklet, started to talk about the work of scientists directly related to the needs of agriculture. For example, a method was developed at the Institute of Plant Physiology that permits assaying protein in wheat without destroying the grain. An automatic instrument has also been proposed. The staff of the Institute of Nuclear Research, Ukrainian Academy of Sciences, and Mironovskiy Wheat Institute of the All-Union Academy of Agriculture Sciences imeni V. I. Lenin participated in the development and testing of this instrument.

The usual analysis takes up to 30 hours and involves destruction of material; the grain is ground up and, after burning it, the nitrogen is isolated. Yet each kernel is precious to the breeder, and sometimes he only has a few small spikes of a new cultivar. Now these kernels are safe. The automatic device can run through 5000 of them per day and it can get complete information from a single kernel, leaving it intact. It is not surprising that Academician V. N. Remeslo, who is not in the habit of gushing with enthusiasm, called this method a "revolution in breeding." Several such automatic devices will be manufactured in the next few years for the major breeding centers.

We proceed further with the guidebook. Another stop. The staff of the Central [Ukrainian] Republic Botanical Garden propose that pepper, cinnamon and cloves,

which are in short supply, expensive and imported, be replaced with vitex, savory, marjoram, basil and geum, i.e., local plants. Is this advice for housewives? No. The recipes and composition of marinades (very simple, no more than three ingredients) have been tested at several canning plants. They are tastier than control samples with foreign spices. The botanists promise to supply seeds and planting material to all agroindustrial associations of the Ukrainian Ministry of the Food Industry within a few years, and they maintain that it is enough to cover an area of 50 hectares with these plants to eliminate spice purchases entirely.

The winter wheat, Kiyanka, was developed at the Institute of Molecular Biology and Genetics. As a rule, a new cultivar is obtained by means of multistep crosses. The needed traits are searched for and developed gradually. But Kiyanka is the result of direct selection by means of selective mutagenesis, and it was obtained by treating Mironovskaya Jubilee seeds. New genes have been added to it.

An objective was defined beforehand in the department of experimental mutagenesis (which is headed by Vladimir Vasil'yevich Morgun, candidate of biological sciences): the new cultivar should be outstanding for its high protein content, early ripening; it should be a semidwarf plant and it should "work for spikes," the main asset, rather than push future straw. A short and sturdy stalk is required, that does not fear either the cold or lodging.

The work on developing the Kiyanka wheat took several years and required much effort. At the present time, state testing of this new cultivar is in progress in various Union and autonomous republics of the nation. And here are the first conclusions: Kiyanka withstands bad weather well and ripens 3-5 days earlier than Il'ichevka, 4-6 days sooner than Mironovskaya-808; its mean yield is 62 quintals per hectare. Up to 80 quintals have been obtained in Poltavskaya, Cherkasskaya, Khmel'nitskaya, Kirovogradskaya, Zaporozhskaya and Krymskaya oblasts. The protein content of Kiyanka is higher than in other cultivars zoned for the Ukraine.

2.

Greenish and yellow powders are being poured into vials. Next to them, on the table, is a stack of photographs; on them are either the outlines of a large crossword puzzle or a wall paved with tiles. These powders are enzymes with rather amazing and useful properties; on the black and white photos are the "portraits" of crystals, taken with an electron microscope.

"The crystallographers of Moscow helped identify the structure of these enzymes or, more precisely, define the properties and area of application thereof," states Rita Grigor'yevna Degtyar', a doctor of sciences from the Institute of Biochemistry imeni A. V. Palladin.

I write down the names: catalase, glucose oxidase....

These enzymes have different action, but their origin is the same: from a fungus (I am omitting its Latin name) that was discovered and first raised at the Kiev Institute of Microbiology and Virology imeni D. K. Zabolotnyy. At first the biochemists were attracted by the antibiotic properties of this fungus: the product derived from it found applications in medicine. But later on, they became convinced that the range of application of the new enzymes is quite broad.

For example, glucose oxidase extends substantially the shelf life of meat, fish and fats. As it reacts with air, it binds oxygen, prevents oxidative processes and, forming hydrogen perioxide, it destroys harmful microorganisms.

We should go into greater detail in discussing catalase.

The enzyme, catalase, has opened the way to a new source of alimentary protein. As we know, the shortage of alimentary protein is constantly growing. Yet there are unutilized reserves: blood of slaughtered animals at meat-packing plants. This is a valuable protein and constitutes one-sixth or one-seventh of commercial production by weight.

Before, only blood serum was used for food purposes, and even then only in part. Catalase, which clarifies blood, makes it possible to use this raw material completely. The unpleasant odors and excessively dark color of the end products are eliminated. The biochemists of Kiev have developed a technology, which is now the basis for industrial production of catalase.

The first device for clarifying blood was installed at the Kiev Meat-Packing Plant. The results were excellent. It was found that one kilogram of clarified liquid blood replaces (in protein content and nutrition) 700 grams of beef, and in dry form it replaces 3.5 kilograms of beef. A dry protein mixture of clarified blood and defatted milk is even more advantageous. It can be added to patees [probably liverwurst] and sausages, as partial replacement of meat and blend (egg), and it can also be used in baking bread, pastries, macaroni and vermicelli.

One of the critical specialists at the Kiev Institute of Hygiene of Nutrition voiced the following conclusion: the protein in the dry mixture is almost entirely assimilated by the body, the mixture itself has excellent dietetic and therapeutic properties, and it can be recommended for children.

The doctoral dissertation of Rita Grigor'yevna Degtyar' dealt with methods of isolating, studying and using enzymes, and it was also based on the data she obtained during her long-term practical work in Kamenka (Cherkasskaya Oblast). Kamenka is a small green city on the banks of the Tyasmin River, a tributory of the Dnepr. The "Russian truth" of Pestel' and plans for the future revolt were discussed at the Davydov estate there by the administrators of the Southern Decembrist Society; Pushkin visited there and, later on, Chaykovskiy worked there on the scores of "Eugene Onegin" and "Swan Lake," and he listened there to Ukrainian folk songs, delighted with their melodiousness.

True, there was hardly any time for an excursion to the "Grotto of the Decembrists," or "Little Green House," where a commemorative literary museum was opened. The Kiev biochemists, microbiologists and technologists spent days and nights in the shop of the alcohol combine, helping adjust and bring up to the planned output the technological line for enzyme production. Their efforts were not in vain: the domestic enzyme is superior to the best foreign specimens, while its cost and selling price are considerably lower than in the United States, FRG or Japan.

The scientists still keep in touch with Kamenka: they offer consultations and help. But still, they spend most of the year in the laboratory, whose windows face the poplar and chestnut trees of Kiev.

There are rows of flasks, lines of glass tubes, jars with products, books in tall wall bookcases and narrow tables put right up against heaters. Cactuses and geraniums, file drawers on old shelves and rolls of papers, tables.... The monotonous, measured sound of the centrifuge blends with the cheerful hissing of gas burners, on which solutions in heavy-walled retorts are boiling. One experiment follows another. One does not rush. Everything must be checked out in a series of experiments before a single figure is put on a line and formulas in an article, an author's certificate or business recommendation.

Catalase will have a lucky fate. The developers of catalase and the new method of clarifying blood, including R. G. Degtyar', were awarded the Ukrainian State Prize in 1978. And still, only one, the very first device is operating, although it was planned to put 14 blood-clarifying shops in operation in the Ukraine and 60 such shops at the nation's largest meat-packing plants.

R. G. Degtyar' came to the Institute of Biochemistry in 1945, after [graduating from] Kiev University. Her choice was motivated by the lectures of Academician Aleksandr Vladimirovich Palladin, one of the founders of Soviet biochemistry, president of the Ukrainian Academy of Sciences and, let us mention, the inventor of vikasol,* the miracle drug that saved the lives of thousands of wounded soldiers during the war years.

Palladin delivered his lectures in an entertaining way, always gathering a large and very attentive audience. The most complicated processes and formulas became understandable and interesting in his presentations.

Aleksandr Palladin, the son of an academician of the Russian Academy, disciple of the physiologists Pavlov and Vvedenskiy, became interested while still a student in a virtually unknown area of science at that time, that of the chemical bases of life. He devoted a total of more than 60 years to the assertion and inception of biochemistry.

Maksim Fedotovich Gulyy, academician of the Ukrainian Academy of Sciences, was also a disciple of Palladin, and he presently heads the institute department of biosynthesis and biological properties of protein. Since 1932 he has worked in this scientific institution, i.e., ever since the institute founded by Palladin moved from Khar'kov to Kiev and became part of the system of the Academy of Sciences.

It is worthwhile to recall those years. The slogans of the first few five-year plans addressed themselves directly to science also, and the scientists responded with enthusiasm to the appeals of those days.

By decision of the USSR Labor and Defense Council, the Ukrainian Academy was involved, for example, in developing the complex problem of the Great Dnepr. This was a problem of erecting power plants, irrigation and reclamation of land in the Ukraine, Belorussia, northern Crimea, and it was necessary to forecast the economic and social results of all these unprecedented transformations.... It would not hurt to recall that, at the end of the last century, the English companies proposed a 98-year concession for the construction of dams [sluices] on the Dnepr rapids; however, they were never able to reach an agreement with the ministers of tsarist Russia.

*A vitamin K preparation used in therapy of hemorrhages secondary to hypoprothrombinemia [translator's note].

The Institute of Socialist Reconstruction of Agriculture was founded, and it was headed by Academician Aleksandr Grigor'yevich Shlikhter, a professional revolutionary, red diplomat and economist. The institute worked on the most important projects, drawing upon sectorial research teams, which was a rare thing in those days. Not everybody was immediately able to appreciate the fruitfulness of joint creativity, joint attack on the unknown.

The first roster of established staff for the Institute of Biochemistry founded by Palladin was modest: one director, three scientists and one employee. The established staff for any present-day chemical treatment center is no doubt more impressive. But soon, the name of the new institute began to resound quite convincingly at scientific meetings. This biochemical institute, the first in the Ukraine and second in the Soviet Union, confidently developed the virgin lands of science, having taken on the study of biochemistry of the nervous system, muscles, intracellular metabolism. Academician Palladin, who did not inhibit the initiative of his young assistants, tactfully suggested directions of research to them. "Respect for science. Respect for labor. Respect for people," could have been his slogan. The institute expanded and Palladin, sparing no time, selected colleagues, followers and those who would continue the started work in the future.

One of the first people that Palladin invited to his institute was Maksim Gulyy, Komsomol member, a recent graduate from the Kiev Veterinary Institute, who had already worked previously in a rural area and completed his graduate studies. Gulyy was from a family of Chernigov grain growers and his father was illiterate.

The famous academician was not mistaken in his choice. In the spring of 1941, Gulyy defended his doctoral dissertation. He parted with the institute only for the duration of the war.

In 1957, Gulyy was elected academician of the Ukrainian Academy of Sciences, and for several years he was its vice-president; after the death of Palladin, who headed the institute for 42 years, M. F. Gulyy took his place in that position and performed his directorial duties as long as it was necessary to the cause.

Maksim Fedotovich will soon celebrate his 75th birthday. He is vigorous and is, as before, an indefatigable worker, infecting his young assistants with his youthful enthusiasm, winning them over with his captious conscientiousness. The UkSSR State Prize was bestowed upon M. F. Gulyy for development of the theoretical bases of technology for the production of blood-clarifying enzymes, a project that he headed and was involved in. Incidentally, as far back as 1952, Gulyy, along with others, was a laureate of the USSR State Prize, for development and introduction to medicine of microcid [glucose oxidase derived from Penicillium vitale], which was recovered from the study of the same microscopic fungus that subsequently yielded catalase.

Gulyy has a very broad range of scientific interests. For many years, the protein question was the focal point among these interests. For example, Maksim Fedorovich proposed and substantiated an excellent method of increasing fat content of cow's milk, based on the use of certain supplements in the feed of ruminant animals.

These studies have tenure, and they have long since been recognized by the animal breeders of our country. As far back as the mid 1950's, a committee for scientific

assistance to kolkhozes was founded under the Ukrainian Academy of Sciences, which also coordinated the testing of scientific recommendations, in particular the recommendations of M. F. Gulyy.

Perhaps one of the most significant studies of this academician is the one that deals with processes of fixation of carbon dioxide in so-called heterotrophic organisms, including higher animals and man. This research, which is original and of great theoretical importance, almost immediately had broad implications for animal husbandry, medicine and the microbiological industry.

It is known that the carbon dioxide absorbed from air is the basis of proteins, carbohydrates and other substances that are formed in plants. In the course of metabolism, plants expire oxygen, which is necessary to all inhabitants of earth. "Give the very best chef as much sunlight as he wants and an entire river of pure water," wrote K. A. Timiryazev, "and ask him to make of all this some sugar, starch, fats and grain, and he will decide that you are making fun of him. But what appears utterly fantastic to man is constantly being done in the green leaves of plants." In organisms whose life is maintained by plant and animal substances, rather than minerals, like plants (which is why they are called heterotrophic) carbon dioxide is the end product of metabolism, the waste of vital functions. It was customary to consider it as waste. The studies of M. F. Gulyy and his colleagues showed that carbon dioxide plays a very important role in metabolism. It was found that heterotrophes, in the first place, assimilate carbon dioxide like plants and, in the second place, require it for synthesis of proteins, fats, sugars, nucleic acids.... The only difference is that plants utilize the energy of light for this purpose, while animals use the chemical energy contained in food products.

M. F. Gulyy demonstrated convincingly and proved--this had also been the topic of his doctoral dissertation--that one can effectively influence the biosynthesis of protein by influencing the process of fixation of carbon dioxide, thus increasing the productivity of farm animals. At first, experiments were conducted on goats maintained by the chair of biochemistry of the Ukrainian Agricultural Academy. Then the experiments were expanded, moved to kolkhoz and sovkhoz farms. Cows, calves, pigs and chickens became the objects of experiments. A new product, carboxylin, was added to feed. The weight gain of animals increased immediately by 10-15%.

Zoologists, zootechnicians and even hydrobiologists became involved in the studies. Carboxylin was tried on fish, milkworms and bees. There was consistent increase in productivity, although less ordinary feed was used. At the height of these studies, at the request of the organizing committee of the All-Union Congress of Microbiologists in Kiev, M. F. Gulyy delivered a paper at a session of this congress. As we know, Gulyy is not a microbiologist, but the organizers of that congress properly reasoned that the very first results of his studies could be immediately applied in the microbiological industry.

Word spread about carboxylin, and biochemists began to visit farms more and more often, demonstrating its advantages.... A total of 25 mixed feed plants in the republic set up production of this product.

But the biochemists did not believe that they had said their last word. They developed new supplements based on carboxylin, MP-15 and MP-30, which have already been

approved by this republic's Ministry of Agriculture, and which are superior to their lucky precursor in every respect. The production plan for these supplements is increasing from year to year in the Ukraine. For example, in 1979 it was planned to produce 620,000 tons.

It is very important that the new products do not destroy the existing feed structure (silage, sour pulp and haylage). They are particularly good for long-term fattening of cattle with sour pulp, and they make it possible to supplement and replace in the diet 15-30% of the protein, as well as to reduce the dosage of expensive concentrates.

Recently, the Ukrainian Academy of Sciences, All-Union Academy of Agricultural Sciences imeni Lenin and Ukrainian Ministry of Health approved a special program that unites the efforts of over 30 scientific institutions for the study of the role of carbon dioxide and ammonium nitrogen in vital functions of higher organisms.

The main center is the Institute of Biochemistry imeni A. V. Palladin, while Academician M. F. Gulyy of the USSR Academy of Scientists is the organizer and one of the administrators of the program. In the summer of 1979, the scientists of Kiev welcomed program participants to the first All-Union symposium, where 80 papers were delivered. Theory joined with practice and, looking at the scope of research today, it is difficult to believe that the experiments of M. F. Gulyy started on the "basis" of two ordinary goats.

"It is logical that agriculture, medicine, pharmacology and the food industry are the steady customers and consumers of scientific output of biochemists," says Maksim Fedotovich, as if to sum up the results. "Carboxylin and feed supplements are the practical issue from our main theoretical theme. In our study of protein biosynthesis and regulation thereof, we discovered a method and understood its realistic advantages. At first, we did everything ourselves. We checked our recommendations, not only in the laboratory, but at kolkhozes and sovkhozes. And it is not by chance that research is expanding primarily at the expense of the budget of the State Committee for Science and Technology. The hair-splitting members of that committee do not give money for the most beautiful idea if it is remote from practice.... Such a situation is agreeable to us. Recently, using this source of financing, we opened two new laboratories, one of immunochemistry and the other of regulation of metabolism."

An incident, about which I had read in the monograph, "The USSR Academy of Sciences, 1724-1974. A Brief Historical Essay," which was published several years ago, today sounds like a sad anecdote of the past. The Russian Academy could not raise 500 rubles for the study of tungsten mines in northern Caucasus (this was during World War I), and at one of the meetings Academician A. N. Krylov, a mathematician, mechanic and ship builder, declared with indignation that an end must be put to this disgrace, that "the entire family of the tsar, which took over the tungsten mines of Transbaykal'ye, would soon go to the devil." They say that Krylov took 500 rubles from his pocket and said: "This is to save our army, which has been left without ammunition."

3.

Nowadays, the only time scientists might lay out funds from their own pockets would be when they are traveling on business, but they do know how to spend wisely public funds generously allocated for research. They calculate well all that determines the national economic effect of their work. Of course, they also try to increase this effect.

It would appear that residues after processing fruit for juice and wine are a trifling matter. However, they contain both fructose and glucose, as well as pectin, which are rather scarce substances with valuable nutrient properties. In the Ukraine alone, more than half a million tons of residue, genuine mountains, are dumped annually.

The staff of the Institute of Technical Thermophysics decided to alter the customary attitude toward this waste of the fruit preserving industry.

If I would write that apple residue is ground up in a special electric worm conveyer device, pressed through draw plates [holes] and, after being spread in one layer on the bottom tray, submitted to thermal and wet processing in a tunnel dryer, ground and separated into different fractions of powder, a specialist would probably smile, reading this superficial description, while an uninformed person would find it incomprehensible.

Let me try to explain what this is about. The powder recovered from the "waste" replaces sugar, citric acid and other products, since it contains 40-70% fructose, glucose, saccharose and pectin. Using the same device, one can simultaneously recover fructose and glucose from fruit pulp and pectin from the skin. A half million tons of apple residue yield 100,000 tons of powder. This saves 90,000 tons of sugar, fructose and glucose, 4000 tons of margarine products and 100 tons of citric acid. The overall annual savings in the Ukraine alone is in excess of 200,000 million rubles.

In the winter of 1979, B. Ye. Paton, president of the Ukrainian Academy of Sciences, reported to the USSR Gosplan about the work of Ukrainian scientists related to agriculture. He began his report with the problem of processing apple residue. The participants at that meeting viewed exhibit specimens specially brought from Kiev (which later traveled to Alma-Ata and Krasnodarskiy Kray, as well, and everywhere drew the attention of business-minded people). It is said that in Moscow, the report of Kremnev, academician of the Ukrainian Academy of Sciences, drew the considerable interest of visitors to the exhibit; he spoke about the prospects of disseminating and introducing the new idea of Kiev scientists. And yet, this did not pertain to either metal, gas or oil, or an extremely complex lathe or new plant.... It pertained to apple residue.

At first, the technology of the process was refined at the institute's installation (it yielded 70 kg powder per hour), then on the experimental production line of the Voroshilovgrad Confectionery Factory (where it already produced 400 kg per hour). Stepan Ivanovich Krupko, director of this factory, did not hinder the scientists and was willing to put up with the extra work. He was soon rewarded, having learned, so to speak, of the fruit of scientific innovations: candy made out of fruit powder. It was highly rated by technological specialists.

The thermophysicists are continuing their experiments. They want to (and are sure they will be able to) recover powder from grapes, plums, pears, apricots, as well as beetroots, carrots and other vegetables.

"In the future, such powders will be valuable raw material for foodstuffs," says O. A. Kremnev with conviction. "Production thereof will help reduce drastically the loss of agricultural raw material when processed commercially. You would not put a spoonful of this powder in a glass of tea, it does not dissolve so well, but for the food industry.... Our immediate plans are to recover powder from sugar beets, and this is new raw material for sugar plants that will not be in danger of spoiling. The Ukrainian business executives approve of this idea. We believe that part of potatoes can also be converted into powder, and so can marine animals: shrimps, crayfish, plankton and other small organisms....."

I have already cited the estimates of economic effectiveness. Here are some more figures: The cost of one line for apple residue is 110,000 rubles, and its annual economic effect is in excess of 600,000. About 2000 such lines are needed for the recovery of residue from nonstandard fruit. This is based on the estimate of harvest under the 11th Five-Year Plan. Of course, one can produce an experimental batch (20-30 units) at the experimental plant of the institute, if material and equipment is allocated to it, but, of course, this is not a solution....

When the biochemist Gulyy defended his doctoral dissertation, which was before the war, Oleg Kremnev, a student at the Kiev Polytechnical Institute, was only getting ready for graduation evening.

His fellow students and instructors on the faculty of heat engineering had no doubt that Kremnev should go into the sciences. In time, he justified their expectations. But there was the long and difficult road of war between the time he received his diploma and the Institute of Thermophysics. During the war he became an officer.

It is only in 1946, after he was demobilized, that Kremnev started to work in the area of science. The institute was helping at that time to restore the republic's power installations, the thermal stations of Khar'kov, Kiev and the Don River Basin. In the meantime, there was gradual accumulation of new ideas, designs of new machinery and substantiation of new technologies.

The ties between scientists and industry strengthened more and more: Oleg Aleksandrovich succeeded in establishing "his own" technological design office with an experimental production shop. Planning covering all production processes, from inception of an idea to its introduction into practice, was organized.

During all these years, Kremnev's deputy, Vladimir Rudol'fovich Borovskiy, doctor of engineering sciences, worked with him; he was also from the glorious cohort of graduates of the Kiev Polytechnical Institute. On the "individual account" of V. R. Borovskiy are some original installations that are in operation at 200 enterprises of the food and chemical industry, and other sectors. The annual savings from use thereof is in excess of 20 million rubles.

On the map that graphically illustrates the business ties of today's heat transfer sector, there are red lines diverging from Kiev to almost all regions of our nation. The scope of research is such that it was necessary to build several new buildings.

Then, almost at the city lines, in Novo-Belichi, a former settlement for truck gardeners and vacationers, in the suburbs of the new academic town, a site was reserved for buildings, where the heat-mass exchange sector of the Institute of Technical Thermophysics was soon founded.... Previously, there was a noisy market there on Saturdays and Sundays. The market was closed down, and in the place of its bins and meandering stalls there were white buildings of laboratories and experimental workshops. Sometimes, the scientists organize unique auctions of ideas there, on weekdays. At these imaginary, of course, auctions, there are no pounding wooden hammers, and the "merchandise" can be examined for months or weeks. Models and mockups of installations developed in that sector take up the entire wall of the office of Academician Kremnev. In the strips of light, its squares sometimes resemble a chessboard used for demonstration, on which the complex games of scientific and technological progress are played.

One can see the same models and mockups, but of larger dimensions, in the display in the passageway between buildings. There, Boris Nikolayevich Protsishin, head of experimental production, was my guide.

The excursion started at a metal cabinet, in which fish can be smoked. First, it (the fish) is soaked in a special product, then it is exposed to a stream of air heated to 200 degrees for 15 minutes.... Ultimately, even the tiny fish, that was previously used for feed meal, becomes a delicacy; you could be treated to it, "fresh from the oven," if such a cabinet were installed somewhere, for example, in a cafe-dining room.

Our excursion ended with an inspection of a model of a heliorefrigeration system, that cools houses in the summer and heats them in the winter; such systems have already been produced for Central Asia, the Crimea and Caucasus, and of a special cauldron, with which one can use the heat of subterranean thermal water to heat residential neighborhoods; such a convenient and inexpensive central heating system has been proposed for Kamchatka, Transcarpathia and Northern Caucasus.

The exhibit offered convincing evidence of the diversity of the scientists' interests, while the fate of my guide, Boris Nikolayevich Protsishin, illustrated the principles of operation of the heat-mass exchange sector. Protsishin, a candidate of engineering sciences, is presently the administrator of experimental production. It would seem that this is a strictly administrative position, but Boris Nikolayevich is involved in scientific work also, as is the custom there. He supervises his own project, and there is a team of collaborators under his supervision.

One of the most recent projects of this team is a new method of recovering nitragin [bacterial fertilizer], which promotes the growth of leguminous crops and fodder grasses--alfalfa and clover. B. N. Protsishin and A. L. Satanovskiy, candidate of sciences, not only developed the technology for manufacturing nitragin powder, but together with representatives of the All-Union Scientific Research Institute of Bacterials tested and introduced it for production at the Lotoshinskiy Biochemical Plant near Moscow. At the present time, the Kiev scientists have contracted to develop a more productive line at one of the biochemical plants in Belorussia. In store for them are the new, though burdensome, but pleasant chores of authors' supervision.

Let me mention another innovation born to the same team of scientists.... It is being used with success at the Latvian Balga Kolkhoz. It is a device to granulate fish feed. Thus far, fish feed was produced in the course of pressing, which involved destruction of some ingredients, decreased biological value of feed, and the shape of the granules was inconvenient for young stock. The Kiev scientists proposed a basically new technology. Now, a solution with vitamin and trace element supplements is made from mixtures in powder form, then it is dried and separated into spherical granules of the needed size, with high stability and good buoyancy. As a result, there is less loss of feed and less pollution of water reservoirs.

"I would say that it is more complicated to create a new technology than to design a new machine," states O. A. Kremnev, academician of the Ukrainian Academy of Sciences. "But it is more necessary and more advantageous.... Recently, the old buildings of a sugar plant in Mironovskiy Rayon, in the Kiev area, were handed over to us. Now we are in a position not only to develop, but to produce, as well as to refine small experimental technological series of equipment. When we deliver an efficient and working device to the customer it is not "a pig in a poke." True, there are still problems with supplies: we have difficulty in getting materials, and when we do it is obtained almost as a personal favor. It is probably time to consider centralized supply of experimental production facilities of institutes. They are growing in number constantly.... On the average, in our sector we have 4-5 technicians and workers per scientist-researcher," Kremnev ends. "This is a rational proportion. But we are broadening and growing because of the orders and contracts with dozens of agencies. We cannot complain of being slighted."

Let me return once more to the guide, on the pages of which, if the reader remembers, we started our "journey" with Academician Babichev.

... The Kiev Institute of Physical Chemistry has proposed a radiation method of processing liquid sewage. It is not inferior to manure with regard to its main constituents. The new technology does not require serious conversion of treatment plants. It operates on the principle of treating the material with a beam of electrons, which is more progressive than the popular method of mechanical decontamination and thermal processing.... This is a more productive technology, it is simpler and can be adopted at the treatment installations of cities and large livestock complexes.

... An installation has been refined at the Nikolayevsk Hydrolysis-Yeast Plant by the microbiologists and Dnepropetrovsk Chemicotechnological Institute, which is used to produce feed yeast of good quality from the stalks of sunflower plants, rice and wheat straw, grape vines and bast-fiber plant chaff. Yet, to this day, this material is burned, or left to rot on the fields.

... The Institute of Hydrobiology has proposed a technology for recovering the organic substances that accumulate on the surface of water reservoirs during the period of mass scale reproduction of algae, as well as methods of processing these substances into a protein-rich feed concentrate. This organic matter (so-called seston [microplankton]) amounts to about 200,000 tons per year, when converted to dry substance, in the Dnepr reservoirs alone. Seston contains 30-40% protein, 20% carbohydrates, much phosphorus, vitamins and trace elements. The product is suitable for feeding fowl, piglets, fish, for recovering aromatic compounds and chlorophyll-carotene paste.

Such are the "sums of technologies," that have already been tested in practice. And here are a few of the current projects of Ukrainian scientists. I shall not interpret them, and hope the readers will simply take my word (I would like to say taste) for the virtually first formulations of planned projects:

The effect of cryoprotective agents on winter hardiness of wheat, vineyards, apple trees (Khar'kov Institute of Cryobiology and Cryomedicine, botanists and plant physiologists of Kiev).

Mathematical model of ecosystems of the main pests of grain crops and potatoes (grain aphid, Colorado beetle, stink bugs [Eurygaster integriceps]) and, on its basis, a working program for optimal methods of controlling them (institutes of cybernetics, zoology and plant physiology).

Research on the heliotechnical bases for augmenting productivity of agricultural crops and developing promising forms for breeding work (institutes of problems of materials technology, molecular biology and genetics)....

But I have been carried away; this is the schedule for tomorrow.

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